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Received - 2021-08-16 02:03:53 PM
Control Number - 52373
ItemNumber - 27

Tesla Comments

Introduction

Tesla, Inc. is pleased to provide these comments in response to the Texas Public Utility Commission's Memorandum on market design. Tesla entities participate in several ways in the ERCOT market: as an industrial electric customer, wholesale storage provider, and a hardware and software provider of energy management products and services used by residential and commercial customers. On a global scale, Tesla is working with load serving entities/retailers, grid operators, utilities, communities, and regulatory entities to build a clean energy future and unlock the ability of Tesla innovations to sustainably modernize the way we consume electricity. These comments center on two themes: (i) ERCOT can benefit from a balanced market design which attracts economic development and energy storage development, and (ii) the Commission can accelerate several initiatives which support distributed energy resources' untapped potential to provide reliability services to the electric grid. Tesla's comments respond to each question in the Memorandum with these themes in mind. Please contact the undersigned for further information.

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Responses**Executive Summary**

- **Operating Reliability Demand Curve (ORDC):** Prices for electricity should reflect the actual marginal cost of energy production, or, when load chooses to curtail, the marginal cost of reduced consumption (VOLL). This benefits all consumers/load. The shape to the ORDC curve should reflect a customer demand curve, so it would be appropriate for the Commission to understand demands and VOLLs when setting a curve (as was suggested in the 2013 London Economics study). Determining the quantity of load that will never participate in the energy market is critical to understand and help set the market design. ORDC should not be contingent on DAM participation. Batteries may not commit in the DAM for economic reasons and should not be penalized for doing so.
- **Participation in Day Ahead Market (DAM):** Tesla recommends improving market signals to incent the right behavior rather than instituting uncompensated constraints on real-time operations. Other US wholesale markets with capacity constructs mandate DAM participation in exchange for a capacity payment, however, increasing DAM participation does not translate to increased real-time reliability in ERCOT's energy-only market. To achieve higher reliability in the energy market, ERCOT should accelerate Real-Time Co-optimization implementation. Further, obligating batteries or other resource in a DAM construct may interfere with the advancements ERCOT is already making to bring more dispatchability to the system, such as through incenting hybrid (DC-coupled) storage-renewable generation.
- **Ancillary Services:** Tesla believes the highest-value reliability actions the Commission can take in the short and medium-term are to accelerate the ERCOT real-time co-optimization project implementation (substantially increase the flexibility of existing and new energy-storage resources) and enable DER Aggregations (Virtual Power Plants) to provide Grid Reliability Services, and adopt market rule changes that allow VPPs to participate in primary and reserve markets (existing and new) which serve ERCOT needs. Retail Energy Providers should be incented to define new customer energy offerings which allow them to hedge their ancillary services (and energy) risks with a customer mix that includes residential customer-sited DERs. If enough customers have DERs in a retail portfolio, the REP will be naturally hedged against ancillary services if DERs can provide them.
- **Residential Programs:** The Commission should prioritize fixes for technical, market, and interconnection hurdles for residential VPPs in the area of market design, technical, and interconnection. Market design questions include zonal v. nodal settlement of residential batteries, thresholds for geographic or other limitations on an aggregation, and allowing exports from aggregated load resources (setting the stage for VPP exports in the future). Technical hurdles include registration and testing (new processes for residential VPPs) – which may require changes to Commission rules. Finally, the Commission should provide explicit direction on the questions of metering and settling VPPs, and, initiate a proceeding to review and modernize interconnection standards for jurisdictional utilities to ensure that customers can avail of available technology to achieve affordable and efficient whole-home backup installations. In

particular, utility interconnection rules do not have processes specified for one-time review and approval of disconnect/whole-home isolation technologies like the Tesla Backup Switch. Disconnect/whole-home isolation technologies like the Backup Switch facilitate efficient and replicable compliance of residential DERs with PUCT Substantive Rule 25.212, and should be widely adopted to support faster, streamlined backup power installation, and make it easier in the long run for retailers and aggregators to leverage DER aggregations.

- **Emergency Load Response:** The Commission should substantially increase the ERS budget and use the increase to fund equipment, control system software, etc. for loads to become price responsive. This could include smart thermostats, smart plugs, home batteries, building control systems, rewiring facilities to separate out different loads by use, as well as developing software to control these elements. By making these loads price-responsive, it will help them fit into the context of the energy market. Helping customers to interact with the energy market by paying them to be ready to do so, in coordination with their REP or an otherwise appropriate retail contract, will improve grid reliability and allow much more load to voluntarily reduce consumption.
- **Reliability Tools for Inertia, Voltage Support:** Inverter-based technologies like energy storage can provide any kind of grid support more with extreme efficiency. As described above, Tesla is providing VPP services with ancillaries in AEMO, regulation service in NE-ISO, and has provided synthetic inertia from its large batteries. In order to encourage the provision of these services, providers should be compensated. All system services should be paid for and be capable of being provided by DERs and batteries so loads can easily hedge these risks. The Commission should also explore non-wires alternatives for transmission and distribution cost deferral and avoidance. Finally, the Commission should consider a product that focuses on long-term storage, such as multi-day or even seasonal storage. This could incent hydropower or new battery technologies to provide much needed multi-day flexibility. Finally, many energy storage devices can be installed in months or weeks in response to an unforeseen or quickly developing need. While Texas is well-regarded for ERCOT's interconnection process, the process could be much improved so that technologies that can be installed quickly are not delayed in interconnecting.

Memo Q. 1. What specific changes should be made to ORDC. To drive investment in existing and new dispatchable generation? Please consider ORDC applying only to generators who commit in the day-ahead market (DAM). Should that amount of ORDC - based dispatchability be adjusted to specific seasonal reliability needs?

Tesla offers these principles to help inform future decision-making on ORDC revisions:

- Prices for electricity should reflect the actual marginal cost of energy production, or, when load chooses to curtail, the marginal cost of reduced consumption (VOLL). This benefits all consumers/load.
- A demand curve slope which triggers ORDC price adders “too soon” (higher slope/less elastic demand) merely penalizes consumers, so any proposals to re-draw the ORDC curve should consider this implication. This is especially true when the adders are a few pennies to a few dollars – this just function as an ongoing revenue shift to generators that customers cannot react to.
- Customer curtailments are more economically efficient when they can curtail at or below their VOLL. Customers whose VOLLs are above the HCAP will have no incentive to curtail voluntarily, which increases the risk that energy will be curtailed involuntarily. The shape to the ORDC curve should reflect a customer demand curve, so it would be appropriate for the Commission to understand demands and VOLLs when setting a curve (as was suggested in the 2013 London Economics study). Determining the quantity of load that will never participate in the energy market is critical to understand and help set the market design.
- ORDC should not be contingent on DAM participation. Batteries may not commit in the DAM for economic reasons, and shouldn't be penalized for doing so.

Memo Q2. Should ERCOT require all generation resources to offer a minimum commitment in the day-ahead market as a precondition for participating in the energy market?

a. If so, how should that minimum commitment be determined?

b. How should that commitment be enforced?

Today's ERCOT DAM is voluntary and participation is economic. Tesla generally recommends improving market signals to incent the right behavior rather than instituting uncompensated constraints on real-time operations. Other US wholesale markets with capacity constructs mandate DAM participation in exchange for a capacity payment, however, increasing DAM participation does not translate to increased real-time reliability in ERCOT's energy-only market. Creating an obligation for a battery to participate in the DAM hinders the flexibility that the battery would otherwise provide in real-time to address the very constraints that the Commission has regarding the sufficiency of dispatchable resources.

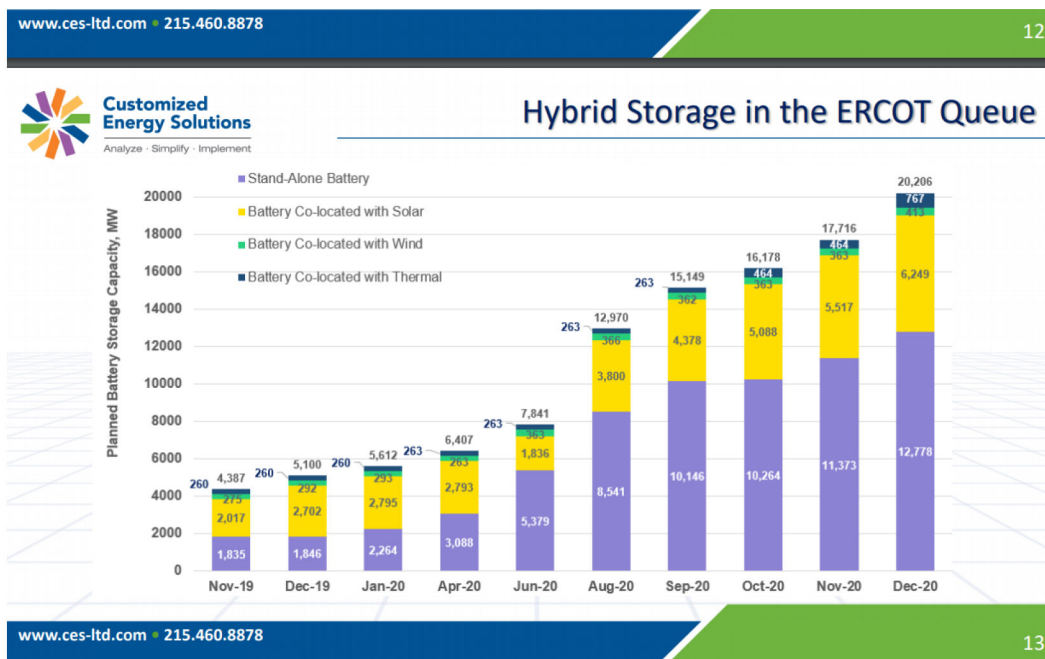
Furthermore, once real-time co-optimization (RTC) is implemented, the real-time market will be the best way to manage tradeoffs between energy and AS participation, and resources should be unencumbered from maximizing the value they provide to the market in real-time by flexibly changing how they operate in response to real-time market conditions.

Implementing RTC will encourage investment in dispatchable generation and should be a very high priority. A lesser priority would be to reform the DAM to have more granular prices. The Commission could encourage batteries to participate more in the DAM by increasing the granularity of settlement in the market to 5 or 15 minutes instead of hourly¹. This will allow prices related to tight ramping conditions – such as when solar is dropping off as evening load is picking up – to be reflected in DAM prices and commitments, and let the market solve this matter more efficiently.

Additionally, the following are implications of mandating battery participation in the DAM:

- The battery must match its state of charge to the DAM committed position, or, risk real-time replacement power costs. This complexity hinders the flexibility that the battery would otherwise provide in real-time.
- Given that storage systems require anywhere from 30 mins to 4 hours to charge in a typical grid-scale use case (system size/duration), there is also no particular reliability benefit to requiring a battery to charge in the DAM.
- Obligating batteries or other resource to a DAM construct to receive ORDC may interfere with the advancements ERCOT is already to make the renewable fleet more dispatchable in the real-time market. For example, in NPRR1029 (12/8/2020) ERCOT approved rule changes that enable the integration of DC-Coupled Resources into ERCOT's core systems. As the rules explain, "large number of projects in the ERCOT generation interconnection queue involve one or more Energy Storage Systems (ESSs) co-located behind a single inverter with one or more wind and/or [PV] generators...This NPRR modifies ERCOT rules to enable market participation of such arrangements." The following table shows a tripling of hybrid projects in the ERCOT queue within a single year (Nov 19 – Dec 2020):

¹ Stéphane Goutte, Philippe Vassilopoulos, *The Value of Flexibility in Power Markets*, Energy Policy, Volume 125 (2019), pp. 347-357, ISSN 0301-4215, <https://doi.org/10.1016/j.enpol.2018.10.024>. ("The concept of flexibility...plays a major role in the remuneration of the resources that generate and consume electricity every day and is likely to play an even larger role with the penetration of large intermittent renewable capacities...We find that the difference between day-ahead and intraday revenues for a flexible resource has been increasing (although the profitability has been decreasing on both markets). This difference is more pronounced once 15 mn price variations can be captured by a flexible resource. The net revenues from the local 15 mn auction (which is held 3 h after the hourly "coupled" day-ahead auction) are more than eight times higher than the day-ahead hourly auction but below the net revenues that can be captured with the high prices from the continuous market. **The results of the backward-looking empirical estimations allow us to distinguish and quantify two components of flexibility: (1) the "immediacy" value as we are approaching real-time and the urgency of the delivery increases (this value is revealed during the continuous intraday process and is highly linked to the stochastic nature of power supply and demand (i.e., wind/solar forecasts, forced outages of thermal generation,...) forecast error risk), and (2) the "ramping capability" component based on the technical characteristics as a resource can react to variations of shorter granularity (15 mn vs. 60 mn)."**) (emphasis added).



Source: Customized Energy Solutions, <https://energystorage.org/wp/wp-content/uploads/2021/01/1.21.2021-Hybrids-Rules-Webinar-Slides-FINAL.pdf>

Similar approaches to advance dispatchability from renewables are being implemented around the country in wholesale markets. FERC-regulated markets were directed in February 2021 to shore up market constructs, modeling, and bidding rules for hybrid resources. These efforts also build on FERC Order No. 841, which directed markets to establish non-discriminatory access for energy storage.

Example: MISO is in the penultimate stage of rolling out its hybrid dispatch model which allows such resources to be incorporated into the MISO 5-minute forecast, and allow full participation of hybrid resources in ancillary services (regulatory reserve, spinning reserve, supplemental, short term reserves, ramping).² MISO is working on product enhancements that facilitate higher participation of hybrid paired resources in the real-time market, such as (i) additional compensation for fast ramp rates, (ii) primary frequency response and reactive power support (new market products), (iii) market compensation for non-wires transmission alternative resources, (iv) new standards for measurement and verification of performance for hybrid resources.³

Memo Q3. What new ancillary service products or reliability services or changes to existing ancillary service products or reliability services should be developed or made to ensure reliability under a variety of extreme conditions? Please articulate specific standards of reliability along with any suggested AS products. How should the costs of these new ancillary services be allocated.

- Accelerate the ERCOT real-time co-optimization project implementation. Real-time co-optimization will substantially increase the flexibility of existing and new energy-storage resources and should be accelerated as much as possible.
- Enable DER Aggregations (Virtual Power Plants) to provide Grid Reliability Services and adopt market rule changes that allow VPPs to participate in primary and reserve markets (existing and new) which serve ERCOT needs. With access for DERs to these market products, REPs would be incented to define new customer energy offerings which allow them to hedge their ancillary services (and energy) risks with a customer mix that includes residential customer-

² Hybrid Generation Resources (June 10, 2021) Integrated Roadmap – Markets Subcommittee (available at [https://cdn.misoenergy.org/20210610%20MSC%20Item%2008%20Hybrid%20Resource%20Market%20Participation%20model%20\(IR086\)558488.pdf](https://cdn.misoenergy.org/20210610%20MSC%20Item%2008%20Hybrid%20Resource%20Market%20Participation%20model%20(IR086)558488.pdf)).

³ [https://cdn.misoenergy.org/20210610%20MSC%20Item%2008%20Hybrid%20Resource%20Market%20Participation%20model%20\(IR086\)558488.pdf](https://cdn.misoenergy.org/20210610%20MSC%20Item%2008%20Hybrid%20Resource%20Market%20Participation%20model%20(IR086)558488.pdf), slide 6.

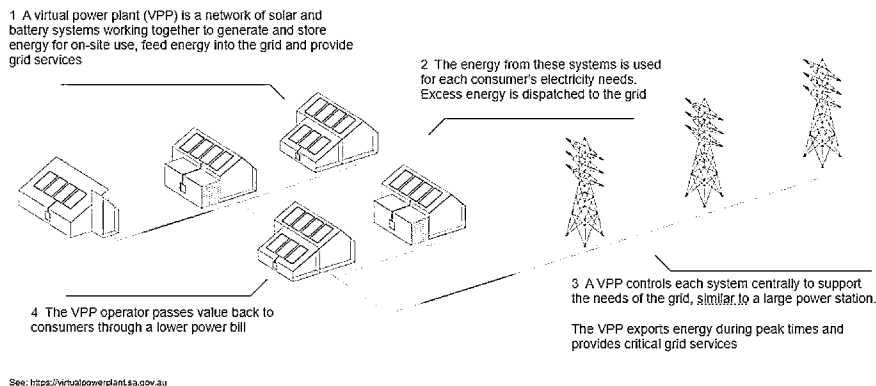
sited DERs. If enough customers have DERs in a retail portfolio, the REP will be naturally hedged against ancillary services if DERs can provide them. (The same is true of the opportunity for Non-Opt-in-Entities to leverage their residential customer-sited DERs in programs to hedge ancillary service and energy price risks).

Ancillary Services and Energy Exports from DERS – 2021 and Beyond

The following explains how VPPs are already aggregating customer-sited dispatchable systems to provide localized and grid-scale reliability services in other jurisdictions in the US and Australia. Much work needs to be done in Texas to unlock this value, where the Commission's direction will be essential.

What is a Virtual Power Plant?

VPPs are a network of battery energy storage systems working together to provide grid support



Source: virtualpowerplant.sa.gov.au

Dynamic Capacity (Stored Energy)

export power to the grid when it is needed most

Tesla's California Virtual Power Plant provides exports back to the grid; California TDU customers who have a Powerwall⁴ can enroll – the VPP was developed in summer 2021 in response to the impact of record high temperatures and severe droughts on CAISO electric demand and generator availability.

In March 2021, the California CPUC Emergency Load Reduction Program implemented new measures which compensate behind-the-meter systems for energy exports during emergency events on a "pay for performance" basis at \$1,000/MWh (equivalent to CAISO's soft energy bid cap).⁵ Third-party aggregators may directly provide and be compensated for providing these services by aggregating customers within the same utility territory (Min. VPP size of 500kW).

In Hawaii, Swell Energy and Hawaiian Electric⁶ are partnering to run a VPP while the utility is also paying customers to add batteries to their solar powered projects; customers must participate in power export events.⁷

⁴ Note: a typical home consumes 1-2 kW of a home battery's capacity; a Tesla Powerwall is a 5kW-7kW system, meaning that on a given day, 80% of the battery's capacity can be dispatched for short durations to respond to peak conditions on the electric grid.

⁵ Decision Directing PG&E, SCE, SDG&E to Take Actions to Prepare for Potential Extreme Weather in the Summers of 2021 and 2022, *Rulemaking 21-11-003* (available at www.cpuc.ca.gov).

⁶ <https://www.solarpowerworldonline.com/2021/01/swell-energy-to-establish-6000-battery-virtual-power-plant-for-hawaiian-electric/>

⁷ <https://www.pv-magazine.com/2021/07/26/tesla-powerwalls-in-california-join-the-movement-to-create-virtual-power-plants/>

Energy Shifting (Demand Response)	
moderating grid power consumption behavior in response to market conditions and transmission and distribution events	The Arizona Public Service Commission is paying customers \$1,250 to add a home battery and allow the battery to export up to 80% of stored energy capacity during grid events and also respond to time-of-use rates for energy arbitrage under a new utility tariff that [permits] the aggregation of distributed energy storage systems that provides compensation for the value each system provides, including, but not limited to compensation for capacity, demand reduction, load shifting, locational value, voltage support, ancillary and grid services, and any other operating characteristic the Commission may deem appropriate.” ⁸
Regulation (Primary Service)	
instantaneous charging/discharging behavior to correct short-term imbalances in electric load and generation	Tesla optimizes dispatch of 1800+ household batteries on behalf of Green Mountain Power, to provide backup power, grid peak shaving, T&D cost reduction, and wholesale market revenue under the ISONE Tariff. The aggregation is the first VPP in the US approved for participation in an ISO/RTO Regulation Market (4-second accuracy).
Contingency (Fast Service)	
<i>Faster support to the grid, used to respond to unexpected failures or outages including on transmission lines, circuit breakers, other electrical elements</i>	The South Australia Virtual Power Plant utilizes local retail partners and the expertise of Tesla to dispatch thousands of Powerwalls in the national electricity market to provide Frequency Contingency Ancillary Services. The VPP has helped arrest frequency problems in the following events: a power station trip in Queensland in October 2019 disconnections of the grid between South Australia and Victoria in November 2019 and January 2020 providing power to Port Lincoln residents during catastrophic fire conditions in November 2019 high and low frequency issues in the grid in December 2019. ⁹ https://www.energymining.sa.gov.au/growth-and-low-carbon/virtual-power-plant

DERs should have access to fast frequency response, primary frequency regulation (RRS services) and any new inertia, voltage support, and frequency contingency products developed in the ERCOT market. If the market rules and products exist, this would be an area for the ERCOT market to evolve towards, leveraging the value of investments customers are already making in their home energy battery systems and providing a value stack of payback. As many REPs discovered in February, ancillary services can be very difficult to hedge and can be quite expensive. With access to these market products, REPs would be incented to define new products that allow them to hedge their ancillary services (and energy) risks with a customer mix that includes customers with DERs. If enough customers have DERs in a retail portfolio, the REP (load serving entity) will be naturally hedged against ancillary services if DERs can provide them.

ERCOT also has plans to implement a new ancillary service in a few years – ERCOT Contingency Reserve Service (“ECRS”). ECRS will help ERCOT to manage intervals when generation and load are ramping up or down very quickly, or respond to generator forced outages. The Commission should encourage ERCOT to create this service as soon as possible.

⁸ In the matter of the AZ Pb. Service Comm. For a Ruling Relating to its 2021 Demand Side Management Implementation Plan - Docket No. no. E-01345A-20-0151, available at <https://docket.images.azcc.gov/E000014299.pdf?i=1626278903042>

⁹ See <https://www.energymining.sa.gov.au/growth-and-low-carbon/virtual-power-plant>

Memo Q. 4. Is available residential demand response adequately captured by existing retail electric provider (REP) programs? Do opportunities exist for enhanced residential load response?

No, the market for demand response could be much larger, and residential demand response and distributed energy resource (DR and DER) aggregations serving as Virtual Power Plants (VPPs) can dramatically improve the reliability of the ERCOT grid. These aggregations are a proven resiliency tool which helps the electric grid operator and utilities coordinate more accurate, faster, and predictable load shed and avert rolling utility outages. Further, operating as a VPP, these aggregated participants could export stored power back to the local utility system during daily demand peaks (reduce distribution network bottlenecks) and export ancillary services through instantaneous charging and discharging behaviors which help restore grid frequency and voltage.

There are no regulatory blockers to enabling a VPP model in competitive regions of ERCOT (nor in non-competitive areas, where utility systems can quickly unlock resiliency value and hedge their load obligations), but there need to be more enablers in the form of ERCOT market rules, forward-looking utility policy, and Commission oversight and direction on difficult or novel questions. Under the current PURA construct, a service provider seeking to aggregate residential customers' capacity to respond to ancillary service price signals would be required to partner directly with a customer, or the customer's retailer, to deliver savings and deliver value back to the customer – in either case, the Commission's leadership on creation of the market-facing and customer-facing programs and protections is essential. In this regard, we provide the following considerations:

- **Just like a natural gas plant, a VPP is fully dispatchable and can provided sub-second response to any frequency excursion.** It can provide MW to the grid by reducing demand on the system at key times. A VPP made up of energy storage devices and solar roofs can also provide ancillary services to the grid, just as efficiently as a utility-scale battery. Even home batteries can provide sub-second responses to any frequency excursion, and the use of open-loop controls means that the response is accurate and fast. Several companies are poised to bring the devices, software, and knowledge and expertise of global markets to Texas to unlock this value: the Commission's leadership is critical to drive the regulatory certainty and investment signals needed for success.
- **Retail Electric Providers can reduce their exposure to financial risks of providing energy and ancillary services** to their customers; this risk has forced some REPs out of business. VPPs formed from REP customers can provide a natural hedge for both super-peak energy hedging, as well as ancillary services that are difficult to procure bilaterally and sometimes expensive. Prior to February 2021, ancillary services were often an afterthought cost-adder for retail prices – but that thinking has changed dramatically since the storm. By paying customers to provide ancillary services to the retailer, the retailer can offer competitive pricing and reduce its own risk – all while helping customers keep down the cost of their own energy consumption and boosting localized reliability.
- **Customers in Texas want backup power** to hedge against grid emergencies. Home battery and solar systems will become a more accessible investment proposition if customers can monetize this investment every day (rather than purchasing these systems as insurance for a bad day) through innovative products and service offerings from their load-serving entity (or REP) which add up front and ongoing value – payments for participation in grid export events, or savings on battery equipment purchases that are offered with lower retail electric rates tied to the capability of the aggregating entity/REP to dispatch excess capacity when it is needed most.
- **Distribution System Planning** is directly affected by the proliferation of distributed solar and storage; residential VPPs can protect customers during outages and keep the local distribution feeder online. They can also defer or eliminate some distribution system costs and provide a public good.

The Commission should prioritize fixes for technical, market, and interconnection hurdles for VPPs

Market design hurdles:

- **Zonal load settlement, but nodal resource settlement.** Loads are settled at averaged zonal prices to keep the retail market simple and not have to explain why a particular neighborhood's prices are 120% of the average ERCOT price. Generators are settled nodally because it can efficiently solve constraints on the bulk power system. Unfortunately, DERs are stuck somewhere in the middle. It is not appropriate to let the load

associated with a DER to buy zonally but the battery to sell nodally, because it could lead to uneconomic arbitrage buying one product and selling another. Therefore, both prices should be the same type. *Tesla recommends zonal/zonal pricing to continue to protect the retail customer.* However, this loses the economic benefits of nodal pricing. To account for this in the short-to-medium term, ERCOT should be allowed to set limits on aggregations based on the possible nodal impacts a DER aggregation might cause. In the medium-to-long term, a viable solution could be that ERCOT develops more load zones, which were last modified with the introduction of the nodal market based on earlier iterations of the zonal market.

- **Geographic or other limits.** In order to allow for this zonal/zonal pricing discussed above, procedures need to be established for when and how ERCOT would set these limits.
- **Exports.** Currently, a rooftop solar panel that exports power receives the zonal price. A residential customer with an existing solar roof and battery system that exports today will also receive a zonal price. This precedent should be allowed to continue for solar plus storage or for storage-only residential VPPs. However, this pricing policy matter will limit the ability for a VPP to export and achieve the full value of the program, which is problematic. Aggregation of exports should be allowed today for aggregated load resources, and that when VPP rules are developed, they immediately allow for exports.
- **Even more exports.** Technically, a VPP on a distribution feeder can keep the whole feeder operating at a minimal level even when the DSP utility is forced to disconnect the distribution feeder to shed customer load. This would require detailed coordination with the customers, VPP, and local utility. But the benefits are obviously enormous, given the experience of Winter Storm Uri. The Commission should begin to explore this policy area in 2022.

Technical hurdles:

- **Registration and testing.** A traditional power plant is a defined size and can be tested and registered in one, long registration process. Utility scale batteries and solar and wind generators are capable of adding more battery cells, solar panels, or wind turbines based on market demands, but the registration process makes that difficult. A residential VPP should be expected to change size at an even higher rate as new customers enroll on a REP's VPP program. The ERCOT registration process must be flexible enough to account for this growth and not create unnecessary barriers. Registration issues should be studied at regular intervals in a pre-defined, simple process, such as every two years. ERCOT should allow a REP or Resource Entity to enroll customers on a VPP program or other aggregated load resource using a new R100 API or through a Texas SET upgrade.
- **Phase-in.** ERCOT may be ready to allow residential VPPs to provide some ancillary services sooner than others. We shouldn't wait for the full package to allow some DER VPP activity. In addition, full integration may require updates to the EMS system or other technical hurdles. ERCOT shouldn't let these matters stand in the way of VPPs, and determine an ad-hoc method for settlement, if necessary, perhaps using the initial/final timeline.

Interconnection:

- **Metering.** Traditional power plants usually have one (or a little over one) ERCOT polled settlement meters (EPS Meters). A residential VPP will have tens of thousands of meters (at least). Therefore, the individual smart meters on customer homes must be sufficient to settle a VPP. ERCOT should engage stakeholders on this topic quickly in order to develop sufficient verification procedures.
- **Modernize Utility Interconnection to Simplify Backup Power Installs:** In order to simplify the residential customer experience and reduce installation timelines and costs for whole-home backup (solar and battery), manufacturers are developing meter collar devices such as Tesla's Backup Switch which can turn two-day heavy rewiring jobs on a customer's home into two-hour installs.¹⁰ Disconnect/whole-home isolation technologies like the Backup Switch facilitate efficient and replicable compliance for residential DERs with

¹⁰ <https://www.tesla.com/support/energy/powerwall/learn/tesla-backup-switch> (Note: The Tesla Backup Switch device sits just behind the meter in the customer-supplied meter socket so all customer load can be routed through it, and connects to the rooftop solar and onsite batteries. The device allows a customer install to be almost as easy as installing a new refrigerator, instead of what today can be an all-day process that involves re-wiring parts of the home. This switch allows simple islanding during an outage and can protect emergency workers by simplifying the electrical work needed to maintain a home backup system over time. It is also much more attractive for the customer's home).

PUCT Substantive Rule 25.212, and should be widely adopted to support faster, streamlined backup power installation, and make it easier in the long run for retailers and aggregators to leverage DER aggregations. However, each TDU has disparate interconnection rules for customer-supplied devices, making it critical to modernize interconnection rules to catch up to the best-available technology being deployed in the field. For example, along with creating a new program for VPPs in all TDU areas to help with extreme weather events, the California PUC has also begun a proceeding this year to develop streamlined interconnection review processes that would allow devices like the Backup Switch to be installed.¹¹ Tesla requests that the Commission develop a process to approve such devices on a statewide basis, then allow them to be installed anywhere the Commission has jurisdiction.

Memo Q 5. How can ERCOT's emergency response service program be modified to provide additional reliability benefits? What changes would need to be made to Commission rules and ERCOT market rules and systems to implement these program changes?

The Commission should substantially increase the ERS budget and use the increase to fund equipment, control system software, etc. for loads to become price-responsive. This could include smart thermostats, smart plugs, home batteries, building control systems, rewiring facilities to separate out different loads by use, as well as developing software to control these elements. By making these loads price-responsive, it will help them fit into the context of the energy market. ERCOT could study the societal savings from increased demand response funded by ERS, and then set the ERS budget based on a portion of the savings. Relatedly, ERCOT could develop a study – to be repeated on a regular basis—examining the benefits of demand response in order to continue to guide the program and reset funding caps based on prior performance and value findings.

Helping customers to interact with the energy market by paying them to be ready to do so, in coordination with their retail electric provider or an otherwise appropriate retail contract, will improve grid reliability and allow much more load to voluntarily reduce consumption.

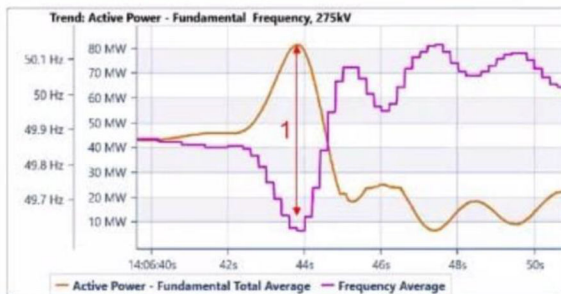
Memo Q 6 - How can the current market design be altered (e.g., by implementing new products) to provide tools to improve the ability to manage inertia, voltage support, or frequency?

Inverter-based technologies like energy storage can provide any kind of grid support more with extreme efficiency. As described above, Tesla is providing VPP services with ancillaries in AEMO, regulation service in NE-ISO, and has provided synthetic inertia from its large batteries. For example, a coal plant in Queensland had an unexpected explosion and fire that shut down the facility, grid frequency dropped, but the Tesla Hornsdale went into “virtual machine mode” to provide synthetic inertia and slow the rate of change of frequency. The same service could be provided from VPPs as well – an objective of the shadow market design work being done currently in South Australia for the 2021+ phase of the VPP program.

¹¹ CPUC Decision 21-01-018, at pp. 70 – 71 (available at <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M361/K442/361442167.PDF>).

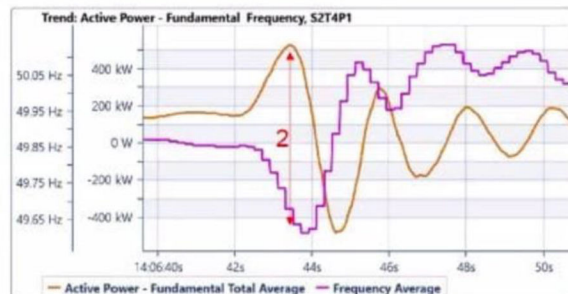
Dual Inverter Trial - Results

- VMM event captured 25/5/2021
- "H" Constant = 50
- Clear response of VMM responding to ROCOF



Site Response

[1] Max active power response at max frequency deviation



VMM Enabled Inverter Response

[2] Max active power response at max RoCoF

Source: <https://reneweconomy.com.au/virtual-machine-hornsedale-battery-steps-in-to-protect-grid-after-callide-explosion/>

In order to encourage the provision of these services, providers should be compensated. All system services should be paid for and be capable of being provided by DERs and batteries so loads can easily hedge these risks.

The Commission should also explore non-wires alternatives for transmission and distribution cost deferral and avoidance. The Texas Advanced Energy Business Alliance's ("TAEBA") DER report from 2019¹² found that estimate the value of T&D deferral in Texas by incorporating DERs at \$344 million per year or \$2.45 billion over 10 years (\$2019 Present Value). On an annual basis, this represents 8.5% of total T&D infrastructure costs. DERs that reduce the need for T&D investment should and could be compensated for doing so.

The Commission should further consider a product that focuses on long-term storage, such as multi-day or even seasonal storage. This could incent hydropower or new battery technologies to provide much needed multi-day flexibility.

Finally, many energy storage devices can be installed in months or weeks in response to an unforeseen or quickly developing need. While Texas is well-regarded for ERCOT's interconnection process, the process could be much improved so that technologies that can be installed quickly are not delayed in interconnecting.

Tesla appreciate the opportunity to file these comments and looks forward to continued participation in these critical market design proceedings.

[Submitted: August 16, 2021]

¹²The Value of Integrating Distributed Energy Resources in Texas. TAEBA. November 2019.
[https://www.texasadvancedenergy.org/hubfs/TAEBA%20\(2019\)/Valuing%20DERs%20in%20ERCOT%20final.11.13.19.pdf](https://www.texasadvancedenergy.org/hubfs/TAEBA%20(2019)/Valuing%20DERs%20in%20ERCOT%20final.11.13.19.pdf)